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Norwegian Primary and Secondary School Teachers' Experiences Using Interdisciplinary Videos That Connect Food and Chemistry

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Abstract

*This study researched food and health (FH) and science (SC) teachers' broad experiences of how nine interdisciplinary food and chemistry videos functioned as pedagogical tools and their suitability in 6th and/or 9th grades at different schools, after the implementation of a new curriculum. In-depth interview data with SC (*n = *3 men) and FH (*n = *7 women, 1 man) teachers' experiences of seven teacher-chosen videos in three schools were analyzed by reflexive thematic analysis, within a design-based implementation research approach. The results showed four main themes: 1) interdisciplinary potential overlooked due to subject knowledge gaps and lack of collaboration experience, 2) the videos were quality pedagogical supplements that teachers needed to use wisely, 3) challenges in using the interdisciplinary videos based on curricula and pupil levels, and 4) support is needed to overcome barriers and reach interdisciplinary potential in schools. The results indicate that videos have pedagogical potential, particularly for 9th graders. The teachers seemed to need curriculum material and school management support to fully realize the interdisciplinary potential of videos, which may be of guidance for curriculum implementation studies. Future studies should include school surveys and broader qualitative studies to explore experiences with videos and supplementary curriculum materials.*

KEYWORDS: **FOOD AND CHEMISTRY, FOOD AND HEALTH TEACHER, INTERDISCIPLINARY VIDEOS, INTERVIEWS, SCIENCE TEACHER**

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Introduction

The term *interdisciplinary learning* has received renewed attention in several national curricula worldwide, as interdisciplinary competencies are increasingly recognized as essential in workplaces and society (Drake & Reid, 2018, 2020; Helmane & Briska, 2017). The concept of interdisciplinarity is described differently nationally and internationally and refers to different levels of integration between disciplines (Drake & Reid, 2018; Helmane & Briska, 2017; Kaufman et al., 2003; Moss et al., 2008; NOU, 2015). In this article, we understand interdisciplinary teaching and learning across curricula as "any form of dialogue or interaction between two or more disciplines" (Moran, 2002, p. 16). Furthermore, we use Bolstad's (2020) conceptual model of four levels of integration between disciplines as a discussion framework. This model is based on Kaufman et al. (2003), and Drake and Reid (2018). Contextually, it fits the Norwegian primary and lower secondary school systems.

The four levels of interdisciplinarity are: 1) intradisciplinary (or fusion), 2) multidisciplinary, 3) interdisciplinary, and 4) transdisciplinary (or curriculum integration). Level 1 represents one school subject that incorporates aspects from another subject. Level 2 represents work that is coordinated with a joint theme but in separate subjects. Level 3 represents subjects interconnected in terms of progression or parallel coordination. Level four represents school subject integration via, for example, a project. Bolstad (2020) argued that there is no "better" interdisciplinarity level, only different forms and, thus, interactions. Importantly, Drake and Reid (2018) suggested a gradual increase in integration between disciplines, aiming for higher levels of interdisciplinarity.

The latest national curriculum in Norway, *The National curriculum for the Knowledge Promotion 2020* (LK20), was implemented late 2020. The core curriculum in LK20 applies to all primary and secondary education and training; it facilitates learning in three interdisciplinary topics (Ministry of Education and Research, 2017): 1) health and life skills, 2) democracy and citizenship, and 3) sustainable development. These three topics are overarching, socially relevant, and serve to develop and bridge competence by working with issues from various school subjects. In addition to the core curriculum, each school subject has its own curriculum with competence goals. The three interdisciplinary topics are stated in connection with competence goals for subjects where this is relevant.

Food and health (FH; internationally known as home economics) and science (SC) are two school subjects with several similarities (Ministry of Education and Research, 2019a, 2019b). Concerning the relevance and central values of these subjects, we can find recognizable content elements, as described by Fooladi et al. (2023). FH is a school subject with great interdisciplinary potential (Haapaniemi et al., 2019) because of the subject's distinctive work with food and practical skills. SC has similar interdisciplinary potential (You, 2017), with an emphasis on experimentation, both theoretically and in a laboratory. The incorporation of knowledge from the FH curriculum into the SC curriculum, and vice versa, is plausible given that practical food preparation tasks, which constitute a significant component of FH, inherently involve the principles of chemistry and physics as exemplified by Paas and coworkers (Paas, Taar, Vänt, Mänik, Rossi, Palojoki, Anttila et al., 2025; Paas, Taar, Vänt, Mänik, Rossi, Palojoki, Haapaniemi, 2025).

Intriguingly, in the preface to the new Norwegian curriculum, official documents used the term *multidisciplinary* (NOU 2015: 8, 2015, p. 49). In the subsequent core curriculum, the government chose to use the term *interdisciplinary* without specifying various approaches to or levels of interdisciplinarity (Ministry of Education and Research, 2017). This allows for tensions and potential ambiguity for schools and teachers regarding curriculum interpretation (Biseth et al., 2022; Karseth et al., 2020).

The challenge with implementation of new curricula remains a recurring curricular dilemma in Norway (e.g. Borgen et al., 2023; Møller et al. 2023) as well as internationally (Drake & Reid, 2020; Gouëdard et al., 2020). Integration between two or more subjects indeed creates possibilities and challenges, within a complex and diverse system like schools. If teachers are guided by competence, autonomy, and relatedness, as described by Ryan and Deci (2000), and at the same time receive school support, they might develop their professional teaching role (Chiu et al., 2024) and potentially facilitate interdisciplinary learning intentions.

Over the past decade, particularly during the COVID-19 outbreak, there has been a consistently growing interest in leveraging digital tools and multimedia resources, such as videos, as pedagogical tools for pupils in primary and lower secondary education (Engeset et al., 2021; Federici & Vika, 2020). More than 50% of FH teachers in Norway occasionally used digital tools, and many wanted to use them more (Beinert et al., 2020). In SC, digital storytelling, including videos, is an example of digital tools that were increasingly used in primary schools (Korukluoğlu & Yucel-Toy, 2022).

As there is currently a lack of pedagogically sound videos connecting FH and SC, we employed a design-based implementation research (DBIR) approach (Fishman et al., 2013; Penuel et al., 2011), seeking critical input from teachers, to support improved interdisciplinary teaching and, possibly, learning. The use of a DBIR approach (Fishman et al. 2013; Penuel et al., 2011), particularly in SC education, has been strongly advocated (Penuel & Fishman, 2012). DBIR typically involves interdisciplinary teams but has not previously been used to include FH subject to our knowledge. Erjavšek and Kostanjevec (2026) has recently performed a Delphi method involving teachers, pupils and parents in home economics, highlighting the importance of involving stakeholders in curriculum development. Indeed, one-size-fits-all is not feasible in curriculum implementation as highlighted by OECD (Gouëdard et al., 2020). As introduced above, the ongoing challenge of implementing interdisciplinary work in schools remains persistent, aligning with a core principle of our DBIR approach (Fishman et al., 2013; Penuel et al., 2011).

First, we developed short videos in collaboration with various school stakeholders; second, we gathered feedback from key stakeholders, specifically teachers, about their experiences using the videos when teaching different pupils. This study explored Norwegian FH and SC teachers' experiences with how nine interdisciplinary food and chemistry videos functioned as pedagogical tools in 6th and/or 9th grades. There are a limited number of previous studies on interdisciplinarity within FH and SC contexts (Haapaniemi et al., 2019; Rauma et al., 2006), and currently no studies on teaching practices following the implementation of the new curriculum in Norway. The research questions (RQs) focusing on teachers' experiences were: 1) How do interdisciplinary videos function as pedagogical tools for teaching purposes in the two subjects?, and 2) How are interdisciplinary videos suitable for different grades and in different school settings?

Materials and Methods

Study Design

This present study concerns a teacher-led intervention using previously developed interdisciplinary food and chemistry videos in 6th-grade (11–12-year-old) and/or 9th-grade (14-15-year-old) pupils in primary and lower secondary schools. Educational design research (McKenney & Reeves, 2020) was used as a broad study design framework, with DBIR as the chosen specific approach (Fishman et al., 2013; Penuel et al., 2011). The chosen implementation support was brief and limited to initial presemester consultations between teachers and the project leader. The reasoning was to mimic stakeholders' contexts of teacher autonomy with methodological freedom, various contextual school structures, and the post-COVID-19 digital era. We used focus group discussions (FGDs) and thematic analysis to analyze and summarize teachers' experiences of interdisciplinary videos as pedagogical tools (Braun & Clarke, 2006, 2022). Furthermore, a relativist ontological and subjective epistemic position was adopted (Dieronitou, 2014; Punch, 2013).

Development Phase of Videos

Nine videos (Table 1) were developed from 2018 to 2019 during the preface to new curriculum implementation in Norway by an interdisciplinary group of teacher educators in SC (n = 1 chemist) and FH (n = 3 FH teachers). The videos were initially planned for upper secondary schools but deemed relevant for primary and lower secondary schools. The thematic focus was on the connection between food and chemistry, and on microbiological food-related processes. The scientific content of the videos was based on food chemistry and technology articles (Jekle & Becker, 2015; Martins et al., 2001) and university-level teaching books (Coultate, 1996; Fennema, 1996).

During the design phase of the videos, action research elements were key, as follows: 1) Short videos explaining chemical processes that occur during cooking were selected. 2) A pilot video was viewed by FH university employees, pupils, and teacher mentors connected to our university (n = 100), who answered an anonymous survey informing the planning of new videos. Feedback was generally positive, including the length, interdisciplinarity, and usability of the video, especially if the video was to be shown before a practical teaching lesson in FH. Also, most informants reported the scientific level as adequate for lower secondary school, that it was nice that a pupil asked the questions, and that they requested tasks related to the videos for future use by the pupils. The latter was not included at this point, as the usability of videos across different grades, subjects, and schools was the main focus at this point. 3) The first three videos produced were shown on an iPad along with a poster at a conference for FH teachers in Norwegian primary and lower secondary schools. Conference participants were asked to provide anonymous comments and suggestions for new videos by adding Post-it notes to the poster as a means of pretesting the videos.

Table 1 Overview of nine short (1.5–4.5 min.) interdisciplinary videos within food and chemistry topics

Video Title and Number (Duration in Minutes)		Short Content Explanation	URL (click CC for English Subtitles)
1)	Baking with Yeast Dough (1:35)	What happens when bread is roasted in an oven (Maillard reaction and caramelization)?	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=148eebf8-3211-451b-a8a4-b05600c2e8a4
2)	What happens when you blend minced meat? (2:15)	The process of adding milk, salt, potato flour, and similar components to bind and dilute food	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=7e189875-c051-4526-bf16-b05400969870
3)	Frying Meatballs (1:22)	What happens when meatballs are fried in the cooking pan (Maillard reaction, swelling)?	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=525fd398-8180-4970-a4e1-b04e00a4fd98
4)	Why does the fruit turn brown? (2:46)	The process of what happens when fruit is cut in two and left on the table (oxidation and how to prevent it)	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=025eee86-f9c6-4bc5-b773-b04f0064998a
5)	What makes yeast dough elastic and big? (1:57)	The importance of gluten in baking for elasticity and how yeast expands dough	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=8db2648a-bb90-49cc-a9d-b04e00ec70e1
6)	What happens when we cook and fry fish? (4:01)	The process of muscle fibers and connecting tissue breaking down, frying makes the fish brown and flavorful	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=c1accd11-18d3-4ace-bcf1-b05600728a73
7)	What happens when we cook and fry red meat? (2:52)	Meat constituents, why we cook/fry meat, the process of muscle fibers and connecting tissue breaking down, browning (Maillard reaction), and different types of meat in relation to the above processes	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=1d4c4450-40e3-4a11-8a9d-b04f00d318d0
8)	What is an egg? (4:29)	Egg components, what eggs are used for, whipping of eggs, and eggs as a thickener of food	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=ae559fde-0191-4b37-96aa-b0550031d438
9)	What is emulsification? (3:52)	Separation when mixing versus the process of emulsification (oil, water, emulsifier)	https://uia.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=e5411d39-e970-4607-ab26-b057010afd90

Setting, Recruitment, and Sample Characteristics

A convenience sample consisting of head teachers from six regional schools was sent an email invitation during the spring of 2021 and, if approved, forwarded to relevant teachers. The criteria for participation were that the SC and FH teachers had to teach in either 6th or 9th grade the following autumn. Four schools approved the invitation; however, due to sick leave, three schools participated. Two municipal schools, both large and small, and one private school, residing in two different cities, were included. Information meetings with relevant and interested FH and SC teachers in the 6th and 9th grades were held at schools during the spring of 2021.

The nine videos (Table 1) were introduced with a short discussion of their relevance to the school's periodical/yearly plans in FH and SC. Teachers were sent links to the videos and decided which ones they wanted to use in classes during the Autumn 2021 semester (August–October). Teachers could include a maximum of three videos each and were encouraged to plan how they would use them in their teaching, or whether they would collaborate with FH or SC. teacher(s) at their respective school. Teachers were provided with the project leader's contact information to facilitate dialog about the project, if necessary. However, they were principally given the autonomy to use the intervention videos as they saw fit. Thirteen teachers used the videos, of which 11 (85%) participated in in-depth interviews (as detailed in Table 2).

Table 2 Overview of schools, teachers' genders, subjects, grades, and videos used

Informant	School	Gender	Teacher's Subject	Grade	Videos Used (Number)								
					1	2	3	4	5	6	7	8	9
AA	A	Male	Food and Health	9		X			X				
AB		Female	Food and Health	9		X			X				
AC		Female	Food and Health	6		X						X	
BA	B	Male	Science	9				X			X	X	
BB		Male	Food and Health	6	X				X			X	
BC		Female	Food and Health	9	X				X				
BD		Female	Food and Health	6	X				X			X	
BE*		Male	Science	9				X			X	X	
CA	C	Female	Food and Health	6	X			X	X				
CB		Female	Food and Health	9	X			X	X				
CC		Male	Science	9				X				X	X

* = individual digital interview. Videos from Table 1: 1 = Baking with Yeast Dough, 2 = What happens when you blend minced meat?, 3 = Frying Meatballs, 4 = Why does fruit turn brown?, 5 = What makes yeast dough elastic and big?, 6 = What happens when we cook and fry fish?, 7 = What happens when we cook and fry red meat?, 8 = What is an egg?, and 9 = What is emulsification?

Focus Group Discussions

Three semistructured FGDs were conducted with groups of three to four teachers (8 FH teachers, 2 SC) who taught 6th and 9th grades. These discussions took place in person at schools or at the university (School C) between November and December 2021, as shown in Table 2. Additionally, one SC teacher from School B provided input through an individual Zoom interview after being unable to attend the focus group discussion, which added valuable perspectives to our data.

The rationale of the FGDs was to acquire in-depth accounts of teachers' experiences of the teaching usability of interdisciplinary videos in FH and SC in 6th and/or 9th grades. A semistructured interview guide focused on the aforementioned RQs with prompts; it included themes such as how the videos were used, advantages and disadvantages, interdisciplinary themes in schools, pupil learning, teachers' own learning from videos, previous use of videos, and suggestions for changes to the videos.

Before starting, the study aim was introduced. All interviews were conducted by two women university FH educators (VG and DE, both associate professors) and FH teachers with nutrition, environment, and health master's degrees; one moderated the interview, and the other made brief fieldnotes. The interview guide was tested in advance through a pilot conducted by two master-level student teachers who practiced with each other.

The moderator showed an image from the nine videos at the start of the FGDs as a means of making the teachers remember which videos they used in classes. The interviews ranged from 35 to 54 minutes, generating transcripts of 11–21 A4 pages. The interviews were audio-recorded, transcribed verbatim by a research assistant, and later analyzed by reflexive thematic analysis.

Reflexive Thematic Analysis

Two of the authors conducted reflexive thematic analysis on the transcripts using Braun and Clarke's framework (2006, 2022). Both analysts were associate professors working as FH teachers: VG (details provided earlier) and TB (man, with expertise in public health nutrition and a background in biology). This method was selected because it is flexible, structured, and broadly applicable to interview data. One FH student teacher at the master's level contributed to parts of the initial analysis. TB had specific experience with the analytical method and had completed additional educational coursework on it.

We employed an inductive approach, examining the complete dataset through the lens of our RQs; 1) How do interdisciplinary videos function as pedagogical tools for teaching purposes in the two subjects? and 2) How are interdisciplinary videos suitable for different grades and in different school settings? This data-based approach was opposite to deductively using predetermined theory or research (Braun & Clarke, 2022) as a narrowing analytical lens. It was chosen as 1) the literature on the theme and RQs was scarce, 2) and the curriculum implementation in Norway was in its early stages, also considering the COVID-19 epidemic. Further, our relativist ontological and subjective epistemic position described earlier, worked to give the selected informants, with their various contexts (different school settings, grades and school subjects), a proper but also researcher interpreted voice. Contextually, we found ourselves within a new curriculum paradigm of interdisciplinarity in Norwegian schools, with its inherent possible tensions as described in the introduction, where our approach of reinforcing unrestricted teacher experiences was appropriate. The analysis focused on identifying both explicit semantic content and underlying latent meanings that emerged during the FGDs. According to Braun and Clarke's (2006) thematic analysis, we first read and reread transcripts several times while taking initial notes, followed by manual coding, merging codes into tentative themes, and structuring data. Themes were then reviewed to sort out a coherent story that the analysis portrayed; this was followed by defining and naming the themes and subthemes, and finally producing a report.

The coding process began with separate individual analyses, followed by iterative and thorough group discussions. This involved going back and forth to debate and refine our interpretations of the data's meaning. Efforts were made to include relevant major and minor data in the analysis. Relevant research and theory, and the authors' understandings were used to critically interpret the data. The Consolidated Criteria for Reporting Qualitative Research checklist (Tong et al., 2007) was used in this study.

Ethics and Privacy Issues

Written informed consent was obtained from the informants, and they could withdraw at any time during the study. This study was performed in compliance with the Declaration of Helsinki, approved by the Norwegian Agency for Shared Services in Education and Research (NSD/Sikt number: 625609), and subsequently approved by the Research Ethics Committee (FEK) at the Faculty of Health and Sports Sciences (FEK number 21/09469-2). Immediately after recording,

the interviews were transferred from the audio recorder to secure digital storage. The data were then anonymized, and the original recordings were deleted from the device. Project data were stored confidentially on a safe server with hard copies of transcripts located in a locked cabinet.

Results

Selected Videos

The included teachers selected seven of the nine videos, with the exceptions being Videos 3 and 6 (see Table 2). Data from FGDs show that justifications for selected videos were based on pupil level, relevance for the teacher's subject, and timing according to their school periodical/yearly plan or curriculum. Other justifications were equipment issues and prior knowledge levels.

Each teacher chose two to three videos. Two SC teachers used the fruit video, cook and fry red meat video and egg video. One SC teacher used the fruit video, egg video and emulsification video. SC teachers all used videos once, except for one teacher who showed the video at both the start and end of class. Seven of eight FH teachers (87.5%) used the "What makes yeast dough elastic and big?" video, of which five (62.5%) also used the "Baking yeast dough" video in combination. Otherwise, the "minced meat," "fruit," and "egg" videos were used by three FH teachers (37.5%). No direct data were available from 6th-grade SC teachers due to illness during the scheduled FGDs. Information about these teachers' perspectives was only available indirectly through their colleagues.

Overview of the Themes from the Analysis Process

During the analysis process, four main themes with two to three subthemes emerged (Figure 1).

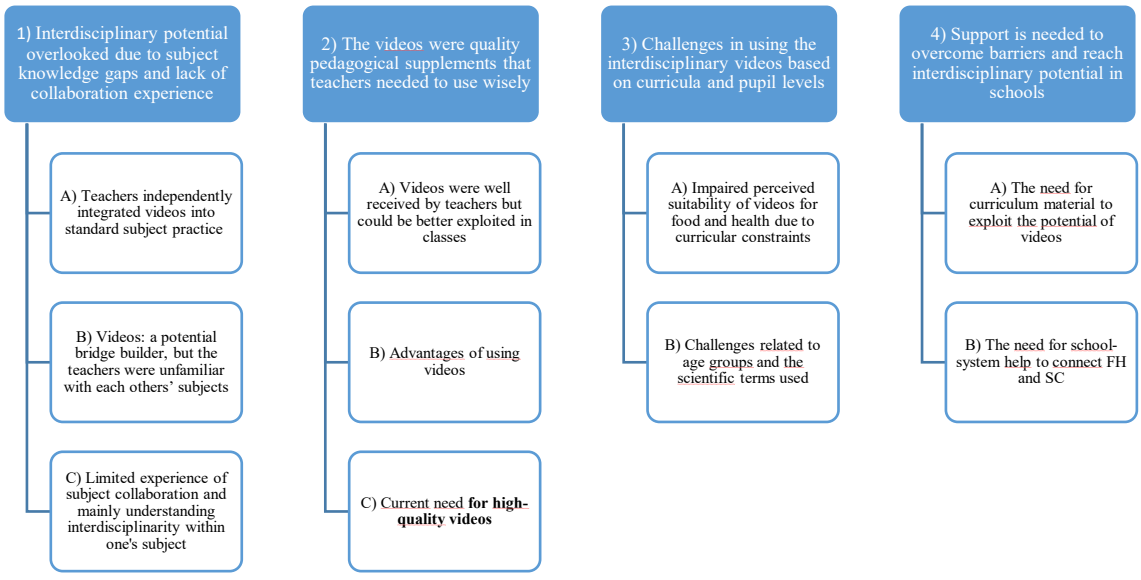

Figure 1 Overview of the main and subthemes emerging from the analysis of data from focus group discussions

Theme 1) Interdisciplinary Potential Overlooked Due to Subject Knowledge Gaps and Lack of Collaboration Experience

A) Teachers Independently Integrated Videos Into Standard Subject Practice.

All the teachers seemed to work in an intradisciplinary fashion and did not collaborate in practice, although a few acknowledged that colleagues used similar videos:

> We worked in an unorganized interdisciplinary way as well because we chose videos individually. (CC).

Most of the SC teachers expressed that they incorporated the videos into a broader teaching arrangement suited to their subject. Seen in detail, this included teaching arrangements such as: 1) experimentation, reflection, researching one's own theories before showing the fruit video, 2) pictures that stimulate thoughts and curiosity, explaining scientific terms before the fruit-related video, 3) explaining the attributes of food ingredients, testing prior knowledge, focusing on selected scientific terms, stimulating curiosity, showing pictures before the egg-related video, and then explaining, 4) tying the theme to everyday events and experiences with food separation, reflecting, and then showing the emulsification video, and 5) viewing the egg video followed by curiosity work, raising questions, and researching answers. This was followed by asking why fruit turns brown, creating a hypothesis, searching for explanations, testing, and trying different solutions, which was all done before viewing the fruit video. Also, the minced meat video was shown as an example of how to start with a question, how to research scientific terms, and how to find a common solution.

The fruit video seemed to be the most relevant video for the SC teachers, as illustrated below:

> I used all the videos once, but we spent a lot more time on one of them [fruit video]. It was easy to connect to the topic on which I was working, which was how to think scientifically; doing experiments. (BA).

The most common approach among FH teachers was to show videos in their theory class once or twice before the practical kitchen class. This was considered appropriate for FH classes, which are typically based on showing videos or practical instruction, cooking, observing cooking processes, and eating the inviting product they presented. FH teachers found the "What makes yeast dough elastic and big?" video most relevant to their subject. One FH teacher showed only the minced meat video in the kitchen. Some FH teachers connected the videos to recipes and asked questions during the cooking process to connect with the explanations in the videos.

Another FH teacher thematically focused on yeast dough for some weeks, and pupils could ask questions when yeast dough videos were shown, as shown in this quote:

> The pupils got to see a little and ask a little, and then it was also referred back to in the food and health class, to the video. Then they say, "Now I'm going to take out the pizza, what if it collapses again?", "Yes, do you remember that from... [video]". "Oh, yes." So that's how we've used them the most. (BB).

B) Videos: A Potential Bridge builder, but the teachers were unfamiliar with each other's subjects.

The teachers expressed a lack of knowledge of each other's subjects. In particular, FH teachers highlighted their unfamiliarity with the chemistry aspects of food science, for example, by saying "I'm not sure about any of the chemistry". Therefore, they chose to avoid some videos, particularly the blending minced meat video, and aspects of the baking yeast dough video. The

traditional ways of working in the FH and SC subjects also seemed to make the subject borders somewhat difficult to cross in practice, although some acknowledged that the videos were "interdisciplinary" and could fit both subjects. However, a few teachers did not initially see interdisciplinary potential when using the videos:

> I don't think I thought much about it [videos] being interdisciplinary then and there, no, but… It's certainly possible [that it was]. (AA).

However, during FGDs, most teachers expressed the benefits of interdisciplinary teaching in theory; for example, "Understanding that the ingredients one adds or how things [recipes] are done matters." A few teachers mentioned the focus on interdisciplinarity in the new curriculum, and that videos could "build bridges between subjects," and they underscored the importance of "connecting to life."

Teachers offered reflections about how pupils benefit from seeing connections across subjects rather than viewing each subject as isolated in its own "box-world." They observed that pupils "learn more" when they can make these interdisciplinary connections:

> The fact that this is relevant in various subjects, they [the pupils] can also feel a sense of achievement. … So it's really good…. So that, we are not disconnected in the school in a way. (AC).

C) Limited experience of subject collaboration and mainly understanding interdisciplinarity within one's subject

Collaborating with other subject teachers, particularly within FH and SC, seemed to be relatively uncommon, despite some saying, "We are encouraged to do more of it [interdisciplinarity] in school." Dialogs across subject borders concerning the videos were mainly restricted to presemester information meetings. Additionally, different teacher teams made collaboration cumbersome. Importantly, some teachers argued that interdisciplinarity should be applied specifically to subjects with relevant connections, such as through the interdisciplinary themes established in the curriculum. One teacher argued that it would be easier if one had responsibility for both subjects or if teachers really were to collaborate across subject borders. Most teachers' main understanding of what works in relation to interdisciplinarity seemed to be focused on connecting subject borders with overlapping themes in their subjects.

Also, some teachers found it futile to collaborate across subject borders, as illustrated in this quote:

> Interdisciplinarity for me is a bit like believing that everyone should constantly collaborate across disciplines, which for me is pure idealism because that doesn't work in practice… (CC).

Theme 2) The Videos Were Quality Pedagogical Supplements that Teachers Needed to Use Wisely.

A) Videos were well received by teachers but could be better exploited in classes.

Overall, the videos were accepted as a "nice supplement." The timing of using the videos was discussed by the teachers. Several FH teachers would ideally use a few videos later in their school periodical/yearly plans, after establishing kitchen routines, or to better fit pupil progress. The main drawbacks expressed by teachers were technical video aspects, although these were minorly significant:

> It has been consistently good quality, if you exclude the acting. (CC).

Some teachers, particularly among FH, were focused on using videos as per "recipe from the university" and, thus, ended up "just showing videos." Teachers generally reasoned that the videos needed to be explored more thoroughly in class, for example, "using 20 minutes of teaching on the three minutes of video." One cannot just show videos quickly to pupils and proceed to other themes in class, they argued. Many teachers wanted to use the videos more expansively in the future (e.g., connected to theory class in FH) as a means to exploit learning potential during cooking.

Alternatively, videos could be used "after cooking lessons." However, an obstacle in some FH kitchens was the lack of screens, and teachers had to bring a laptop or show videos when they had theory sessions in the kitchen, as they did not have access to theory rooms. Some teachers highlighted better coordination or planning among teachers as vital for pupils in terms of learning progress. Videos were not shared with pupils or given as homework or as a test or repetition, which, according to some teachers, could be useful.

B) Advantages of using videos

Several advantages of videos were highlighted by teachers, and the elaborations were, for instance, "short" "and thus fitting limited time in lessons, "easy," "concrete," "theme-based," "explanative with writing and drawings," and "easy to use repeatedly." Some teachers highlighted that the "video format is well suited for pupils" as long as it is not a "sleeping pill" being overused by teachers. "Adding variation" and "stimulating engagement and motivation" were highlighted by some teachers.

The fact that videos explain the *how and why of food processes (chemical processes)* compared to other available videos was underscored by some teachers:

> Exactly how a dough grows larger or something turns brown, ...that's probably something which appeals more to their way of getting an explanation of why it happens, so maybe that makes it more accessible, also the fact that they're [the videos] not long, that's hugely important… (BC, an FH teacher).

Also, the fact that pupils potentially encountered videos in two different subjects was underscored by some teachers. One SC teacher pinpointed that the videos enabled working on "research on a tangible thing," as processes related to food or real life, for example, rust, are often used in SC. One FH teacher was even inspired to focus more on chemistry in FH classes. Some also said that they learned the subject content themselves from the videos.

C) Current need for high-quality videos

Several teachers reflected on the fact that the videos were "scientific," "credible," and "of quality." Pure cooking videos, or commercial ones from internet portals such as Matprat.no, were commonly used in FH classes; thus, intervention videos were a "scientific supplement" according to several FH teachers. SC teachers saw the need for such videos "in their video bank" as well. Other videos commonly used in teaching were viewed as more superficial (like YouTube.com), and thus of "less scientific value" and could include commercials. Teachers would like even more thematically broad interdisciplinary videos in the future. A desire was also expressed to connect the school and university through noncommercial, trustworthy pedagogical tools, such as the following quote:

> There is also a quality aspect—knowing that the information presented [in the videos] is scientifically sound. When you find content on YouTube, while basic skills like cutting vegetables might be straightforward, you could easily encounter misleading videos, especially regarding controversial topics like meat consumption. Without proper vetting, these videos could lead pupils completely astray due to potential biases or inaccuracies. (BB).

Theme 3) Challenges in Using Interdisciplinary Videos Based on Curricula and Pupil Levels

A) Impaired perceived suitability of videos for food and health due to curricular constraints

Generally, more SC teachers than FH teachers expressed coherence between their subject, curriculum, and the use of videos. SC teachers seemed to be able to delve deeper into the themes, even though chemistry is a specific theme and not a broad theme in an SC curriculum. This was underscored in a quote from an SC teacher:

> So, I can see that it is interdisciplinary, but I think that you could put on the same video and say that it was science. And you could have taken the same video and also said that it was an extended food and health… with chemistry… (CC).

Through FGDs, a few FH teachers highlighted that some videos and cooking classes in the kitchen, typical of FH as a subject, became slightly "two separate parts," implying that support is needed to bridge this gap didactically, as shown here:

> A lot of it was probably a little more science-oriented because I can't find exactly what I should have justified it with in relation to the competence goals [in FH]… (BC).

B) Challenges Related to Age Groups and the Scientific Terms Used

While most selected videos seemed to be relevant for both 6th and 9th grade teaching situations, 9th grade was generally more suitable. There was a bit more need for tailoring the videos to the 6th-grade level. The scientific level was a bit high for some pupils but also relevant for academically strong pupils, the teachers argued. Some themes were fit for upper secondary school but depended on how teachers introduced the topic, and it could also be beneficial to see "the next level," teachers argued.

A particular challenge was the use of several unfamiliar or challenging scientific terms not extensively covered in the videos. This was particularly a challenge in FH classes, where the teachers expressed that they did not usually go into chemistry details in theory during the cooking sessions. Ideally, a few FH teachers would have to add a theory lesson to support pupils, but that was not always feasible. Several teachers addressed the need for videos to be tailored specifically for age suitability with respect to thematic content and scientific terms. This would potentially improve the learning outcomes for the pupils, the teachers emphasized.

A few teachers also did not remember or understand the scientific terms from the videos during FGDs and suggested that terms need to be worked on more in class:

> Well, one noticed that there was a difference in level, and concepts in particular. For example, in 'Why do fruits turn brown?'. I think [that video] was actually easier for them to understand than [the video of] baking yeast dough. Because there was talk of aromas and… there were actually many such terms and you could feel that they [the pupils] were kind of like 'Hey, what does that mean? Or… There were a lot of foreign words and many things that maybe should have been worked on more, which we didn't do then… (CB).

Theme 4) Support is Needed to Overcome Barriers and Reach Interdisciplinary Potential in Schools.

A) The Need for Curriculum Material to Exploit the Potential of Videos

Several teachers implied that the videos alone were "not enough" as pedagogical tools to envision interdisciplinary work. They elaborated that the videos could preferably be part of "a curriculum material" from our university, with the following suggestions for content: 1) A concrete didactical teacher guide with each video, 2) goals and tasks for pupils with assessment suggestions, 3) explanation of scientific terms, and 4) an easily recognizable link to the curriculum and competence goals in both subjects, supporting interdisciplinarity.

This was exemplified by an SC teacher:

> And perhaps even more so that it will not only be a video, but had there been a slightly more complete curriculum material around it… maybe with experiments, maybe with a division as to what food and health, to what science can do. With suggestions for follow-up work, suggestions for work along the way, and maybe even a type of assessment or, in a way, I think we are all looking for… (BE).

B) The Need for School-System Help to Connect FH and SC

Around half of the teachers underscored that they, as teachers with busy school schedules, needed support connecting the two subjects. "School administration," "joint ownership of project," and "school structures" were highlighted as crucial for successful teacher processes and subsequent pupil learning. Examples given by teachers were "limited free time" and "resources" for interdisciplinary work (i.e., planning and coordinating school periodical/yearly plans to achieve "real collaboration" and to support "progress").

One teacher pointed out how school management could help with interdisciplinarity:

> When we had interdisciplinary work in a primary school, we had a whole day to sit and plan it. So, there is an incredible amount of planning for it to be able to go ahead, but for those pupils who somehow find writing and school stuff boring, the interdisciplinary session we had there was incredible for different pupils. If we manage to get more of it [interdisciplinarity] into the school so that they see that what we are doing is important in various arenas, then I think that we can at least create motivation for those children, but it is demanding—it is the [school management] that has to help us with that. (CA).

Especially in lower secondary school, teachers work more with their subjects and are less flexible timewise, as some teachers pointed out. These barriers were less evident in primary school, although time was the main factor highlighted as a bottleneck for working across subject borders.

Discussion

Our DBIR study examined the discrepancies between how the teacher-selected interdisciplinary videos were designed versus how they were actually implemented in classroom settings (Fishman et al., 2013; Penuel et al., 2011), within the context of the early stages of a national curriculum implementation in schools. Specifically, we looked at how a set of interdisciplinary videos function as pedagogical tools for teaching purposes in FH and SC, and how are the videos suitable for different grades and in different school settings.

The teachers provided rich input during one iterative cycle of collaboration (Stage 2 of the DBIR). The interdisciplinary videos were found to be pedagogically useful in both SC and FH, particularly in 9th grade, and across the three diverse schools (although issues were raised concerning scientific terms). Various barriers at the personal, subject, and school levels were indicated. Teachers suggested that school-facilitating factors, such as curriculum materials and a school system that supports interdisciplinarity, could potentially harness greater interdisciplinary potential in schools.

In the following, we use Bolstad's (2020) conceptual model of four levels of integration between disciplines as a discussion framework. Competence is fundamental for developing a professional teaching role and enhancing pupil learning (Chiu et al., 2024; Jentsch & König, 2022). For interdisciplinary teaching, teachers must possess skills beyond their subject areas (Drake & Reid, 2018).

Our FGDs indicate a gap in FH and SC teachers' knowledge across subject boundaries (see, e.g., Rauma et al., 2006) and a lack of practical interdisciplinary experience beyond the intradisciplinary level (Bolstad, 2020). These individual barriers require structural-level solutions if we hope to achieve higher levels of interdisciplinarity, as intended in both national and international educational agendas (Drake & Reid, 2018; Meld. St. 28. (2015–2016), p. 37; Ministry of Education and Research, 2017; NOU 2015: 8, 2015, p. 49). Building interdisciplinary competence and practical training should begin in teacher education (Norwegian Ministry of Education and Research, 2017) and continue throughout teaching careers.

Our data suggests that the use of videos needs to be pedagogically well planned and fit into a school's periodical/yearly plan and curricula (Ministry of Education and Research, 2019a, 2019b). Supporting videos with concrete curriculum material might help realize the teaching potential of videos, as curriculum materials are important guiding tools in SC (Davis et al., 2016) and FH (Hernes, 2009; Rauma et al., 2006).

Curriculum materials are resources that guide teacher instruction in the classroom (Stein et al., 2007). Low self-efficacy, as described by Bandura (1997), may have hindered FH teachers' confidence and ability to fully utilize the interdisciplinary videos in our study, particularly regarding SC competence. For in-house SC teachers, the number of SC subjects studied, teaching experience, and the desire to teach with an interdisciplinary approach appeared to be important for achieving high self-efficacy (von Knebel et al., 2023). The notion of self-efficacy also best explains SC teachers' views on integrated SC education. This influenced their implementation of such education and their need for support (Haatainen et al., 2021).

The teachers in our study appeared to didactically select videos that were "close to home:" familiar and directly relevant to their subject comfort zones. This fits with the subject-specific contextual factors and working methods of FH and SC (Ministry of Education and Research, 2019a, 2019b). Furthermore, this may be a sign of alignment with core subject competencies and strong teacher autonomy with regard to choosing didactical methods (Veka et al., 2020).

FH is the smallest subject in Norwegian schools. Indeed, data from a Norwegian case study on the previous curriculum indicates that 6th-grade FH teachers seem to work individually and thrive with high autonomy with regard to planning their teaching. This suggests that their pedagogical and didactic positions dictate their teaching more than the curriculum does (Veka et al., 2018, 2020, p. 217–234).

SC is a larger school subject with a potentially greater professional community in schools, and is supported by professional learning communities' initiatives, as exemplified in Potvin et al. (2024). Though working on an intradisciplinary level (Bolstad, 2020), our SC teachers were generally more in line with the explorative perspective and pupil-centered learning found in the new national curriculum (Ministry of Education and Research, 2017). The bottleneck of teaching time is more evident in FH, with 197 hours compared to 650 hours of SC in primary and lower secondary schools. This may have hindered a more elaborate and explorative approach in FH, which could facilitate time for more pupil reflections, discussions, and critical thinking, such as that shown in Finland (Taar & Palojoki, 2022).

Internationally, primary and lower secondary schools are experimenting with various levels of interdisciplinarity in FH (Rauma et al., 2006) and SC (Haatainen et al., 2021; von Knebel et al., 2023). Finland, as an example, shows that such attempts seem to be more structured, with an integrative approach to learning (Haapaniemi et al., 2019), consistent with Drake and Reid (2018). In contrast, our study indicates the need for a more structured approach by school leaders to support teachers' interdisciplinary work, which is in accordance with Bolstad (2020), Gouëdard et al. (2020) and Nevenglosky, Cale and Panesar Aguilar (2019).

It is important that interdisciplinary efforts are not solely dependent on interested and competent teachers, as this makes such initiatives arbitrary rather than structural. A report by Borgen et al. (2025) indicated that interdisciplinary work is less common in practical–aesthetic subjects, suggesting more support for such small subjects.

Although the Norwegian Directorate for Education and Training (2025, May 2) is facilitating the implementation of the new curriculum, supported by teacher education, it is up to schools and their teachers how to approach this current era of interdisciplinary teaching. The transition to new curricula can be arduous (Gouëdard et al., 2020; Mabunda, 2023), often with a lag in which teachers adhere to previous school practices (Veka et al., 2020). There are indications that teachers in our study, in the early stages of curriculum implementation, are still in a learning process with regard to interdisciplinarity. There are also indications that the COVID-19 pandemic likely hampered curriculum implementation in Norway as well as globally, emphasizing the need for additional time and support (Borgen et al., 2023, Møller et al., 2023;).

A lack of time has been reported in earlier integration studies (Rauma et al., 2006). A report by Burner et al. (2022) suggested that school management is important for the implementation of a new curriculum through joint cultural school practice in professional teaching communities. Also, there is variation in support and organization, according to the teachers in Burner et al.'s (2022) report. There are indications to support that a lack of subject prioritization is particularly evident in smaller subjects, such as FH (Borgen et al., 2023). Thus, joint planning time seems to be important for achieving interdisciplinarity, according to the teachers in another study (Furberg et al., 2023).

According to a study (Biseth et al., 2022), Norwegian teachers found interdisciplinarity important when they participated in preparatory courses on the new interdisciplinary curriculum. However, this was less reflected in their current practices, highlighting tension within "the implementation gap" (Gouëdard et al., 2020) Correspondingly, our informants were generally positive concerning the potential for interdisciplinarity in theory. Several informants mentioned a desire for real collaboration (i.e., beyond interdisciplinarity) and touched on relatedness in FGDs, in line with Ryan and Deci (2000). As they had not collaborated with colleagues during the project, the informants appreciated the interdisciplinary discussions facilitated during FGDs.

In practice, their understanding of videos was mainly limited to working within their subjects, achieving Level 1 of Bolstad's (2020) model. This suggests a gap between interdisciplinary theory and practical school practice in line with Gouëdard et al. (2020), with potential barriers where teachers' interpretation of the videos in light of the curriculum was not met by contextual framework factors in the school.

Helmane and Briska (2017) discussed features, including critiques of various levels of integration in integrative teaching, namely multidisciplinary, interdisciplinary, and transdisciplinary. Intradisciplinary work may be easier and safer with regard to teacher competence, and such an approach avoids possible tensions with regard to teacher autonomy in teacher collaborations. Higher levels of interdisciplinarity require teamwork and communication, which by nature may be more time-consuming (Bolstad, 2020), and which appears to be a barrier in the implementation of the curriculum (Gouëdard et al., 2020).

A study of interdisciplinary teaching teams in Norwegian lower secondary schools indicated negotiations as well as coordination issues (Havnes, 2009), which our informants also expressed concern about. Furthermore, Havnes' (2009) study suggests the dilemma of reestablishing the school culture regarding teaching practices based on the involved teachers' experiences. Creating a shared project-collaboration with ongoing discussions seemed to be an important strategy for such interdisciplinary teams. Correspondingly, collaboration with other subject teachers might pose a potential obstacle to autonomy.

A Finnish study of home economics teachers showed no major issues with autonomy while working with integrative teaching (Haapaniemi et al., 2021). We can only speculate whether this is, in part, due to a more structural approach to interdisciplinary work. de Santana Santana and Prestes Massena (2024) argued that SC teacher autonomy is derived from interactions in school. In Norway, the collective teaching culture is connected to autonomy among teachers (Skaalvik & Skaalvik, 2021). Likewise, our data suggests that relatedness is important, which is aligned with Ryan and Deci (2000), and this should be considered in interdisciplinary work.

Overall, our results show interdisciplinary potential among Norwegian FH and SC teachers, particularly for achieving higher levels of interdisciplinary work as described by Bolstad (2020), which aligns with the new curriculum's interdisciplinary goals (Meld. St. 28. (2015–2016), p. 37; Ministry of Education and Research, 2017; NOU 2015: 8, 2015, p. 49). A more joint understanding among school leaders, teachers, and national curriculum governmental bodies of how to work in an interdisciplinary fashion may be a way forward in Norway and other countries with similar challenges.

Contextual framework factors, such as school leader support for competence building as interdisciplinary teachers, and relatedness connected to this process through allocating time and physical meeting places, were indicated as important in our study, and in line with core component three of DBIR and the above discussed literature. This is especially relevant in lower secondary schools, where time constraints and limited teacher autonomy present greater challenges. Additionally, this approach addresses developing schools' capacity for sustained systemic changes like interdisciplinary work, aligning with the fourth core component of DBIR previously discussed.

Strengths and Limitations

To the best of our knowledge, this study is the first to report on the latest national curriculum implementation between FH and SC with regard to interdisciplinarity in Norway. Although recurring themes were evident during the analysis, three schools with seemingly varying interdisciplinary cultures and variations in how often the videos were tested must be considered when interpreting the results. Data saturation may not be a goal in inductive research (O'Reilly & Parker, 2013). However, the above discussion, together with coherent results across schools, suggests that the issues raised by teachers are relevant concepts in schools.

One limitation is potential informant selection bias, with only three science teachers (all men) and no representation from 6th grade due to availability constraints. One individual interview was included due to the elaborate data on the use of videos. As not all teachers were present at the presemester information meeting, and the video testing period was limited to a few autumn months, how teachers approached the project and which videos were selected may have impacted our findings. Neither of the data researchers has a formal teaching background in SC; however, both have had interdisciplinary experience and some thematic relations with SC. A strength of this study is that data analysts were independent from the video design and usability testing processes, while feedback from key DBIR stakeholders included both positive and negative perspectives.

Conclusion

The interdisciplinary videos were well received as pedagogical tools in FH and SC subjects (particularly in the 9th grade) and across the various schools, but their use needs to be pedagogically well planned. Despite Norway's new national curriculum emphasizing interdisciplinary teaching, teachers continued traditional subject-specific approaches when implementing food and chemistry videos. This present study suggests barriers to interdisciplinary teaching at the individual, subject, and school levels. Key facilitators for realizing future interdisciplinary potential, according to our DBIR teacher study, include school management support and curriculum materials that complement the videos.

Future studies should include school surveys and broader qualitative studies of teachers', school leaders', and pupils' accounts. Early-stage teacher involvement during pedagogical tool modifications is also essential for success. Collectively, these approaches could possibly enable successful implementation and nationwide scaling in curriculum implementations across Norwegian schools, and possibly internationally, if DBIR design or similar approach is chosen.

Data Availability

The anonymous data supporting the findings of this study are available upon request from the corresponding author, TB.

Declaration of Interest Statement

The authors declare that they have no competing interests.

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TB, VG, DE, and MR conceptualized and designed this study, with PP contributing to the study design. VG and DE (FH teachers) collected data, while VG led the project and acquired funding. TB and VG analyzed and interpreted the data during the first phases and TB in the final phases (with input from VG). TB led the drafting of the manuscript, while all the co-authors contributed by reviewing and editing it; all approved the final manuscript.

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